Section: Orthopaedics

Original Research Article

EVALUATION OF FUNCTIONAL OUTCOME OF MOSIACPLASTY IN GRADE4 OSTEOCHONDRAL DEFECT

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ABSTRACT

Background: Osteochondral defects of the knee are challenging, especially in young athletes, due to their potential to cause persistent pain and early-onset osteoarthritis. The osteochondral autograft transfer system (OATS) offers a promising single-stage surgical solution by transplanting healthy cartilage and bone to the damaged site. **Materials and Methods:** This study involved 20 sports persons aged 15–40 years with isolated grade IV osteochondral defects (2.0–4.0 cm²) on the femoral condyle. All underwent OATS procedure. Functional outcomes were assessed using Lysholm, International Knee Documentation Committee (IKDC), and Tegner scores preoperatively and at a minimum of two year postoperatively. Magnetic Resonance Imaging (MRI) evaluated graft integration and articular congruity. **Result:** The average defect size was 2.51 cm². Postoperative assessments showed significant improvements: Lysholm scores increased from 49.85 to 92.9, IKDC from 48.69 to 91.37, and Tegner from 2.13 to 8.5. MRI confirmed successful graft integration in 95% of cases. One patient exhibited partial graft issues, managed conservatively. **Conclusion:** The OATS procedure demonstrates excellent functional and radiological outcomes for treating focal osteochondral defects in sports persons, facilitating a return to sports and daily activities with minimal complications.

INTRODUCTION

Osteochondral defects of the knee occur when a unit of articular cartilage is removed from the surface of a joint with or without a portion of the underlying bone. These can occur as a result of mechanical factors (i.e. trauma or overuse leading to repetitive micro trauma) or biological factors (i.e. osteochondritis dissecans or osteonecrosis).[1] While lesions can occur in the elbow, ankle, and wrist, the most common site of involvement is the knee. Specifically the medial femoral condyle (70%–80%), lateral femoral condyle (15%–20%), and patella (5%–10%) are the common locations within the knee.[2] Symptomatic defects can cause pain, locking, swelling and functional impairment with reports that these symptoms can be worse than those of an anterior cruciate ligament-deficient knee.[1] Focal chondral lesions of the knee impair quality of life to a similar degree as in patients scheduled for knee replacement and provoke symptoms and reduced function to a greater degree than that of patients about to undergo a reconstruction of a torn anterior cruciate ligament. The natural history of these defects typically results in the production of type I collagen in the form of fibro-cartilage, rather than type II collagen normally found in articular hyaline cartilage. Fibro-cartilage has poorer characteristics with regard to resilience, stiffness and wear properties and, as such, has a predilection for advancing arthritis.[1]

Osteochondral autograft transfer is one of several approaches to cartilage repair. Other techniques include marrow stimulation, cell-based strategies, and allograft transplantation. Optimal treatment for

symptomatic knee lesions remains controversial. Osteochondral autograft transfer (OATS) is a one-stage surgical procedure to treat chondral defects of the knee and other articulating surfaces. The advantages of OATS include the use of autologous tissue, which avoids the potential risks and costs associated with allograft transplantation as well as the use of a structural graft with both bone and cartilage. This may be advantageous over marrow stimulation or cellular treatments, which only address the chondral component to the pathology. Primary advantage of OATS is it retains hyaline cartilage and patient weight bearing can be started early.[3] In the present study, we aim to evaluate the functional and radiological outcomes (MRI based), after OATS in isolated osteochondral injuries in sports persons.

MATERIALS AND METHODS

A total of 20 active sports persons younger than 40 years old who were seen with a primary grade IV osteochondral lesion of the weightbearing surface of medial or lateral femoral condyle between 2.0cm2 to 4cm2 were treated with OATS technique and prospectively evaluated after two year of post operative period at least. The inclusion criteria of the study were: A recreational or competitive level sports person with age equal or more than 15 years to 40 years having isolated primary grade IV osteochondral defect of knee with articular cartilage damage ranging from 2.0 cm2 to 4.0 cm2 in area with normal contralateral knee. The exclusion criteria were previous injury or surgery on the knee and concurrent osteoarthritis or injury of the anterior cruciate ligament, posterior cruciate ligament, lateral collateral ligament, or posterolateral complex of the knee, grade III or IV tear of the medial collateral ligament and meniscus injury.

Time and final outcome after OATS to return to routine physical activity and sports, was assessed as per Lysholm score, IKDC subjective score and Tegner score and a postoperative MRI was done at 12 months post-op to assess the structural integrity, healing status and survival of graft.

Surgical Technique: All procedures were performed by a single experienced orthopaedic surgeon. Patients were positioned supine under spinal or general anaesthesia, with a tourniquet applied to the upper thigh. The affected knee was prepared and draped in a sterile manner.

Arthroscopic Assessment: The procedure began with a standard diagnostic knee arthroscopy through anterolateral and anteromedial portals. This allowed for thorough inspection of the joint and precise evaluation of the chondral defect. The size, depth, and location of the lesion were documented. The damaged cartilage was then exposed using a small medal or lateral para patellar incision, the defect was debrided using shavers and curettes, and the defect edges were shaped into stable vertical walls with a flat, well-prepared base.

Donor Site and Graft Harvesting: A small open incision was made over the periphery of the femoral condyle—typically in a non-weightbearing area such as the lateral or medial trochlear ridge. A cylindrical osteochondral plug was harvested using the Arthrex OATS donor harvester. Graft diameter (usually between 6 and 10 mm) was selected based on the size of the lesion. The harvesting instrument was aligned perpendicular to the joint surface to ensure a smooth, intact graft with preserved cartilage integrity.

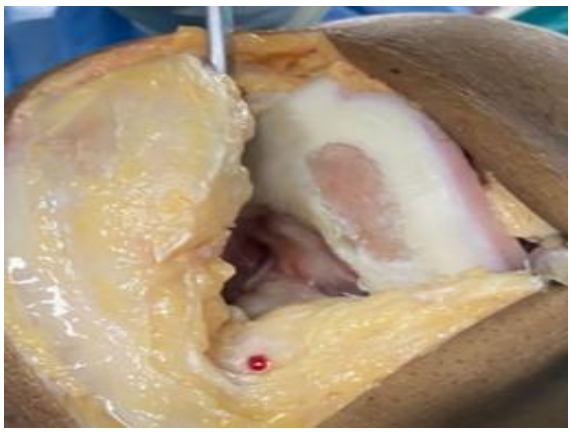

Figure 1: Showing articular cartilage defect over medial condyle

Figure 2: Showing harvesting of graft from lateral edge of trochlea

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Figure 3: Showing harvested graft

Recipient Site Preparation: Attention was then turned back to the defect site. Using sizing guides and the Arthrex recipient reaming instruments, a matching socket was created at the defect location. The reamer was introduced perpendicular to the joint surface to ensure a precise fit. The depth of the recipient socket was matched to that of the donor plug to ensure a flush graft position.

Graft Insertion: The harvested osteochondral plug was inserted into the recipient site using a delivery tamp. Gentle tapping ensured that the graft was press-fit securely into the socket. Proper alignment was confirmed, with the goal of achieving a smooth transition between the graft and surrounding native cartilage. No additional fixation was needed due to the tight fit.

Wound Closure and Rehabilitation: After confirming stability and joint congruency, the joint was thoroughly irrigated. All incisions were closed in layers, and a sterile dressing was applied.

Patient was discharged after 24-48 hrs of surgery and kept non weight bearing for 2 weeks. Stitch removal was done at 2 weeks.

Figure 4: Showing placement of graft at recipient site

Table 1: Rehabilitation protocol

Modality	Time Frame
Range of motion	Immediate full, active range of motion
Brace	Not required
Weight bearing status	Partial weight bearing at 2–4 weeks and full weight bearing after 4 weeks, depending on pain and limitation of knee movement
Closed chain exercise, straight leg raises	Immediate postoperatively
Light recreational sports	At 4–6 months postoperatively
High-impact sports	At 6 months postoperatively

Statistical Analysis

Data was analyzed with Microsoft Excel and SPSS software version 26.0. Mean and standard deviation of the quantitative variables were measured. For categorical variables, significant group differences in the distribution of proportion was estimated by using the chi-square test or Fisher's exact test. P value ≤0.05 was taken as significant.

RESULTS

A total of 20 patients were enrolled in the study. The majority were males (75%) and aged between 21 and 35 years. Most defects were localized to the medial femoral condyle (90%). Baseline characteristics including BMI and pre-injury activity levels are summarized in [Table 2].

Table 2

Variable	Number	Percentage
Gender		
Males	15	75.0
Females	5	25.0
Affected side		
Right	12	60.0
Left	8	40.0
Site of defect		
LFC	2	10.0
MFC	18	90.0
BMI classification (Asian)		
18.5–22.9	6	30.0
23–24.9	6	30.0
25–29.9	8	40.0
Total	20	100.0

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Activity level of patient before onset of disease		
Competitive sport	8	40.0
Recreational sport	12	60.0

The mean size of the cartilage defect was 2.51 ± 0.37 cm² (range: 2.04–3.33 cm²). Most defects (60%) were between 2–2.5 cm², 30% were 2.5–3 cm², and 10% were 3–3.5 cm².The number of graft plugs used per patient ranged from 2 to 5, with a mean of 3.25 plugs.

The graft plug size used was 8 mm in 65% and 10 mm in 35% of cases, with a mean of 8.7 ± 0.98 mm. The number of graft plugs used per patient ranged from 2 to 5, with 40% requiring 3 plugs, 35% requiring 4, and 20% needing 2 plugs.

Table 3: Graft Characteristics

Parameter	Mean ± SD	Range	Distribution (%)
Defect Size (cm²)	2.51 ± 0.37	2.04–3.33	2–2.5 (60%), 2.5–3 (30%), 3–3.5 (10%)
Graft Plug Size (mm)	8.7 ± 0.98	8–10	8 mm (65%), 10 mm (35%)
No. of Graft Plugs	3.25 ± 0.72	2–5	2 (20%), 3 (40%), 4 (35%), 5 (5%)

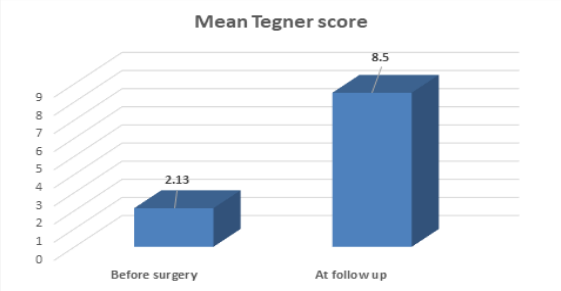


Figure 5: showing preoperative and postoperative mean Tegner score

The mean time from surgery to pain-free weight bearing was 6.55 ± 0.89 weeks. Patients returned to physical activity after a mean duration of 9.7 ± 1.56 weeks. While return to sports was after a mean duration of 24.4 +-2 weeks.

MRI at follow-up showed 95% (n=19) of cases had complete graft healing, while in 1 patient (5%) MRI showed ongoing healing at 12 months. MRI at follow-up showed articular surface congruency was maintained in 95% of patients; while in 1 patient (5%) cystic degeneration and delamination was observed and was conservatively managed.

No statistically significant differences were observed in functional outcomes based on the site of the defect (MFC vs LFC) or preoperative activity level (competitive or recreational sports), indicating uniform efficacy across subgroups. The summary of key postoperative outcomes is provided in [Figure 5 and 6].

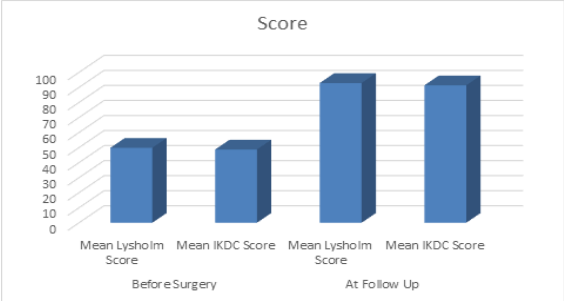


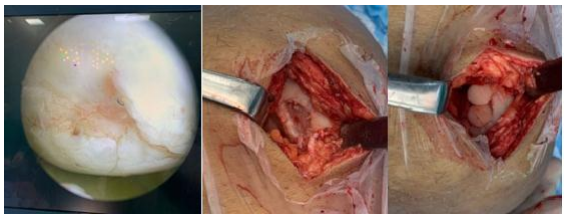
Figure 6: showing preoperative and postoperative mean Lysholm and IKDC score.

Table 4: Functional score (Pre vs Post)

Outcome Measure	Preoperative Mean ± SD	Postoperative Mean ± SD	p-value
Lysholm Score	49.85 ± 11.51	92.9 ± 4.59	0.006
IKDC Score	48.69 ± 10.91	91.37 ± 4.03	0.012
Tegner score	2.13 ± 0.84	8.5 ± 0.93	0.0001

IKDC subjective scores also improved significantly from a pre-op mean of 48.69 ± 10.91 to 91.37 ± 4.03 at follow-up (p=0.012). The minimum and maximum preoperative scores were 34.48 and 74.71, and postoperative scores ranged from 79.3 to 96.55. Tegner activity level scores increased from a mean of 2.13 ± 0.84 preoperatively to 8.5 ± 0.93 postoperatively (p=0.0001). The preoperative range was 1–3 and the postoperative range was 7–10. Lysholm scores improved significantly from a preoperative mean of 49.85 ± 11.51 to 92.9 ± 4.59 postoperatively (p=0.006). Preoperatively, 90% had poor scores and 10% had fair scores. Postoperatively, 55% had good, 40% excellent, and 5% fair outcomes. Significant improvement was noted in both Lysholm, Tegner and IKDC scores postoperatively.

CASE 1



A. Arthroscopic Image Showing Osteochondral Defect. B. Intra Operative Image Showing Osteochondral Defect. C. Intra Operative Image Showing Placed Graft Plugs

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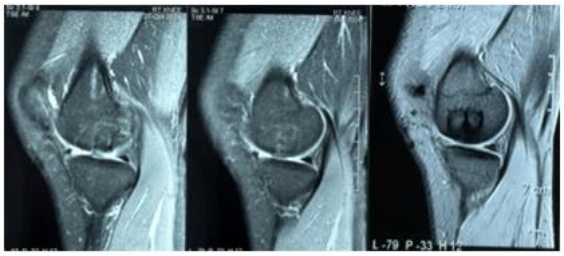
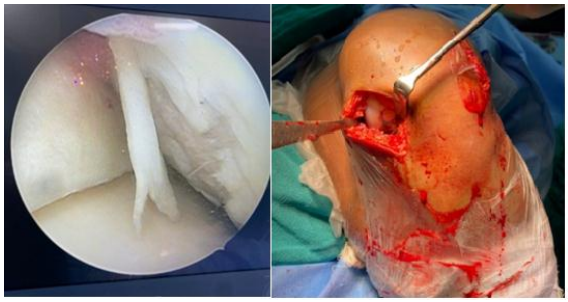
Pre Operative MRI

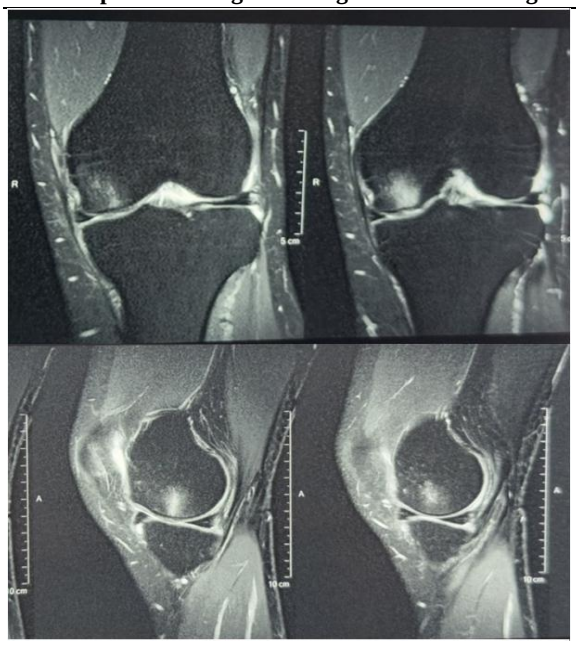


MRI at follow up

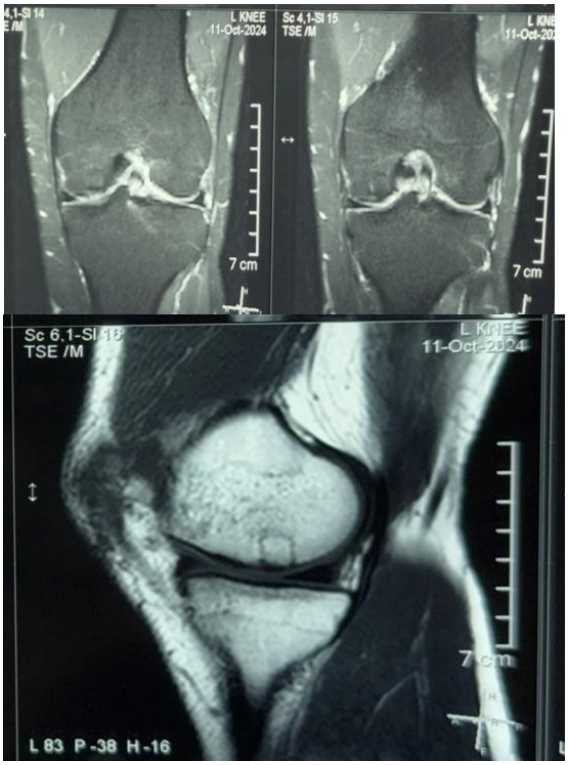
CASE 2



A. Arthroscopic Image Showing Osteochondral Defect.
B. Intraoperative Image Showing Placed Graft Plugs.



Pre Operative MRI



MRI AT FOLLOW UP

CASE-3

Intra Operative Image Showing Osteochondral Defect

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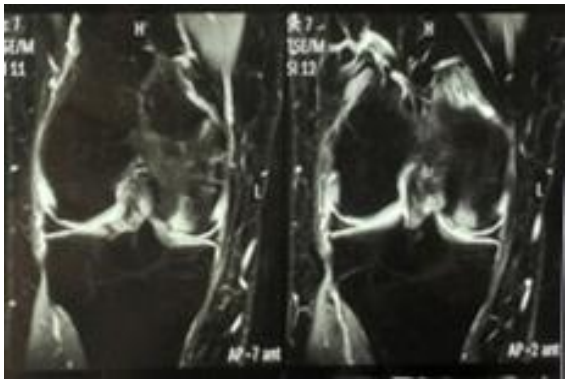
Intra Operative Image Showing Placed Graft Plugs



Pre Operative MRI

MRI at follow up showing cystic degeneration & delamination

DISCUSSION

This prospective analysis was conducted to assess the clinical outcomes of OATS procedure in sports persons with isolated grade 4 osteochondral defects of the knee. The study primarily focused on evaluating postoperative functional improvement, radiological outcomes (MRI based) and identifying potential complications associated with the procedure.

In terms of laterality, a majority of the cases (60%) involved the right knee, which aligns with previous reports by Shekhar et al. (2021),[4] Chow et al. (2004),[5] and Alpaslan Ozturk et al. (2006),[6] suggesting a possible predisposition toward right-sided involvement. Though the etiology of this predominance remains uncertain, it may be related to limb dominance or activity patterns.

Anatomically, the medial femoral condyle (MFC) was the most frequently affected site, accounting for 90% of the cases, while only 10% had involvement of the lateral femoral condyle (LFC). This trend mirrors the distribution reported by Chow et al,[5] and Solheim et al,[7] emphasizing the MFC as a common site for high-grade cartilage injuries, possibly due to biomechanical load and anatomical configuration.

The mean defect size observed in this study was 2.51 ± 0.37 cm², which falls within the range described in prior literature, including Hangody et al,[8] (2010) and Keszeg et al. (2022).[9] These findings support the appropriateness of mosaicplasty for treating medium-sized cartilage lesions.

Postoperative functional assessment demonstrated significant improvement across all indices. The Lysholm score improved markedly from a preoperative mean of 49.85 ± 11.51 to 92.9 ± 4.59 at follow-up ($p = 0.006$), with 95% of patients achieving good to excellent outcomes. These results are consistent with those of Alpaslan Ozturk et al.6 and Chow et al,[5] who reported similar improvements and high satisfaction rates.

Similarly, the IKDC subjective score showed a statistically significant rise from 48.69 ± 10.91 preoperatively to 91.37 ± 4.03 at follow-up ($p = 0.012$). These outcomes align closely with those published by Marcacci et al,[10,11] and Reverte-Vinaixa et al,[12] underscoring the efficacy of osteochondral autografts in restoring knee function.

In our cohort of sports persons engaged in competitive / recreational sports, the Tegner activity score increased significantly from 2.13 ± 0.84 to 8.5 ± 0.93 ($p < 0.001$), highlighting a notable return to pre-injury activity levels. While this improvement is higher than values reported by Marcacci et al,[10,11] and Gudas et al,[13] it reflects favourable rehabilitation outcomes in our cohort. Importantly, no significant differences were observed in outcomes based on defect site (MFC vs. LFC) or preoperative activity level, though comparative data remain limited.

Magnetic Resonance Imaging (MRI) performed during follow-up provided further insight into graft viability. In 95% of cases, the graft was well-integrated, and the articular surface was congruent. One patient (5%) exhibited cystic degeneration and delamination, findings that are consistent with those reported by Reverte-Vinaixa et al,[12] and Marcacci et al,[10,11] Notably, no complications were observed at the donor site, underscoring the safety of the procedure when performed with meticulous technique.

Regarding postoperative recovery, the mean duration to pain-free weight bearing was 6.55 ± 0.89 weeks, and return to physical activity occurred at an average of 9.7 ± 1.56 weeks, while return to sports was after a mean duration of 24.4 +-2 weeks. These recovery times are clinically acceptable, though comparative benchmarks in existing literature are sparse.

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CONCLUSION

In conclusion, the results of this study reaffirms the OATS procedure as a reliable option for treating focal full-thickness cartilage defects of the knee, offering significant functional improvement in sports persons with low complication rates. This prospective study evaluated the functional and radiological outcomes of mosaicplasty (osteochondral autograft transfer system, OATS) in patients with grade 4 osteochondral defects of the knee. The findings of our study align well with existing literature, confirming the efficacy of mosaicplasty / OATS in restoring knee function, particularly in young, active sports persons. The high rates of graft healing, improved performance indices, and minimal complication rates emphasize the reliability of this technique.

Our study has limitations of a small cohort and a shorter follow up period and thus a continued follow-up and larger prospective studies are recommended to validate long-term outcomes and refine patient selection criteria.

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